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Anderson

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(54) **HEAT SHIELD FOR A MARINE ENGINE EXHAUST SYSTEM**

(71) Applicant: **Indmar Products Company, Inc.**, Millington, TN (US)

(72) Inventor: **Timothy G. Anderson**, Munford, TN (US)

(73) Assignee: **Indmar Products Company, Inc.**, Millington, TN (US)

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F01N 3/22	(2006.01)

(Continued)

(52) **U.S. Cl.**

CPC ***F01N 3/32*** (2013.01); ***F01D 25/14*** (2013.01); ***F01N 3/05*** (2013.01); ***F01N 3/20*** (2013.01); ***F01N 3/222*** (2013.01); ***F01N 3/30*** (2013.01); ***F01N 11/007*** (2013.01); ***F02B 37/168*** (2013.01); ***F02C 7/24*** (2013.01); *F01N 3/323* (2013.01); *F01N 2560/025* (2013.01); *F01N 2590/021* (2013.01); *F05D 2220/40* (2013.01);

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See application file for complete search history.

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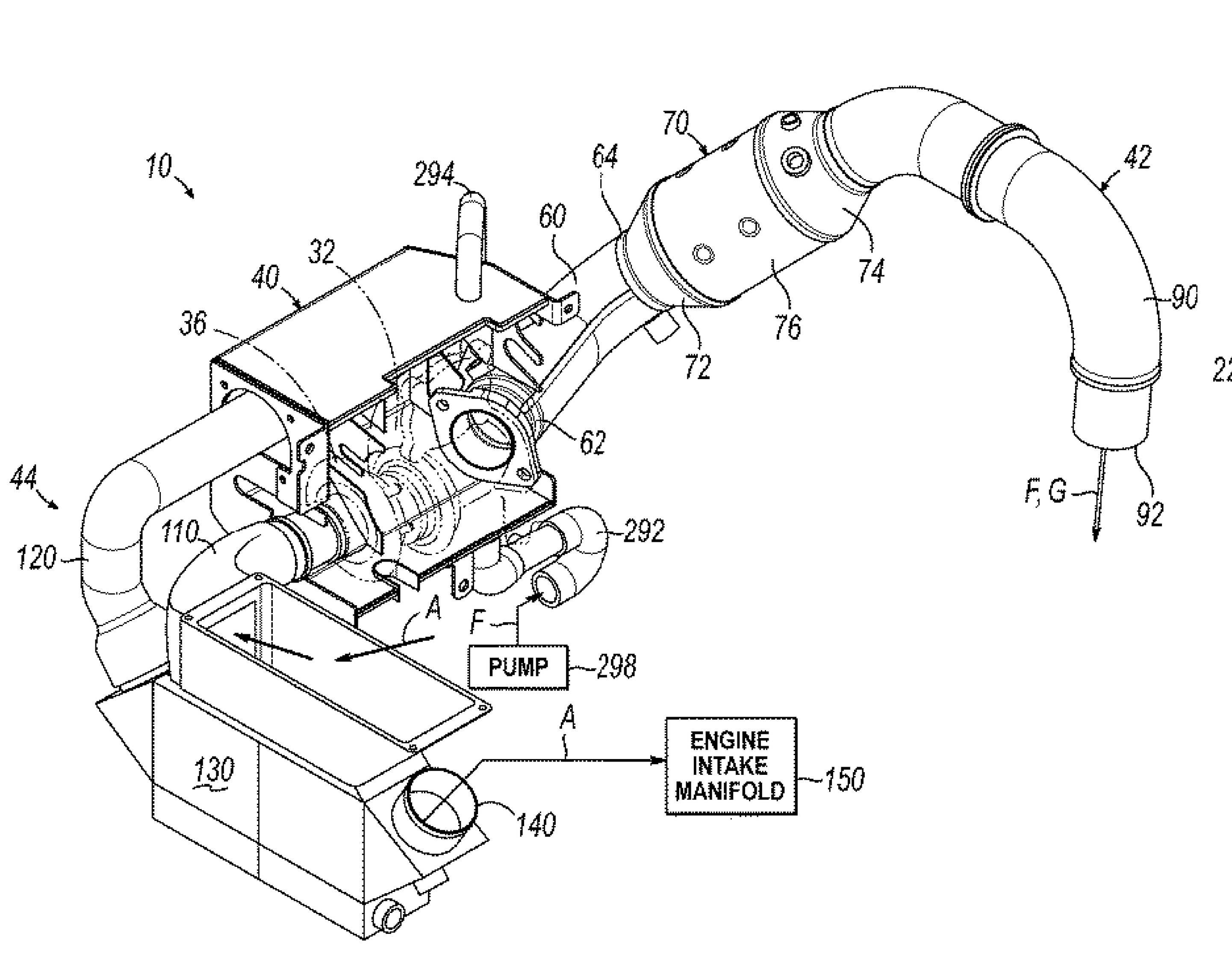
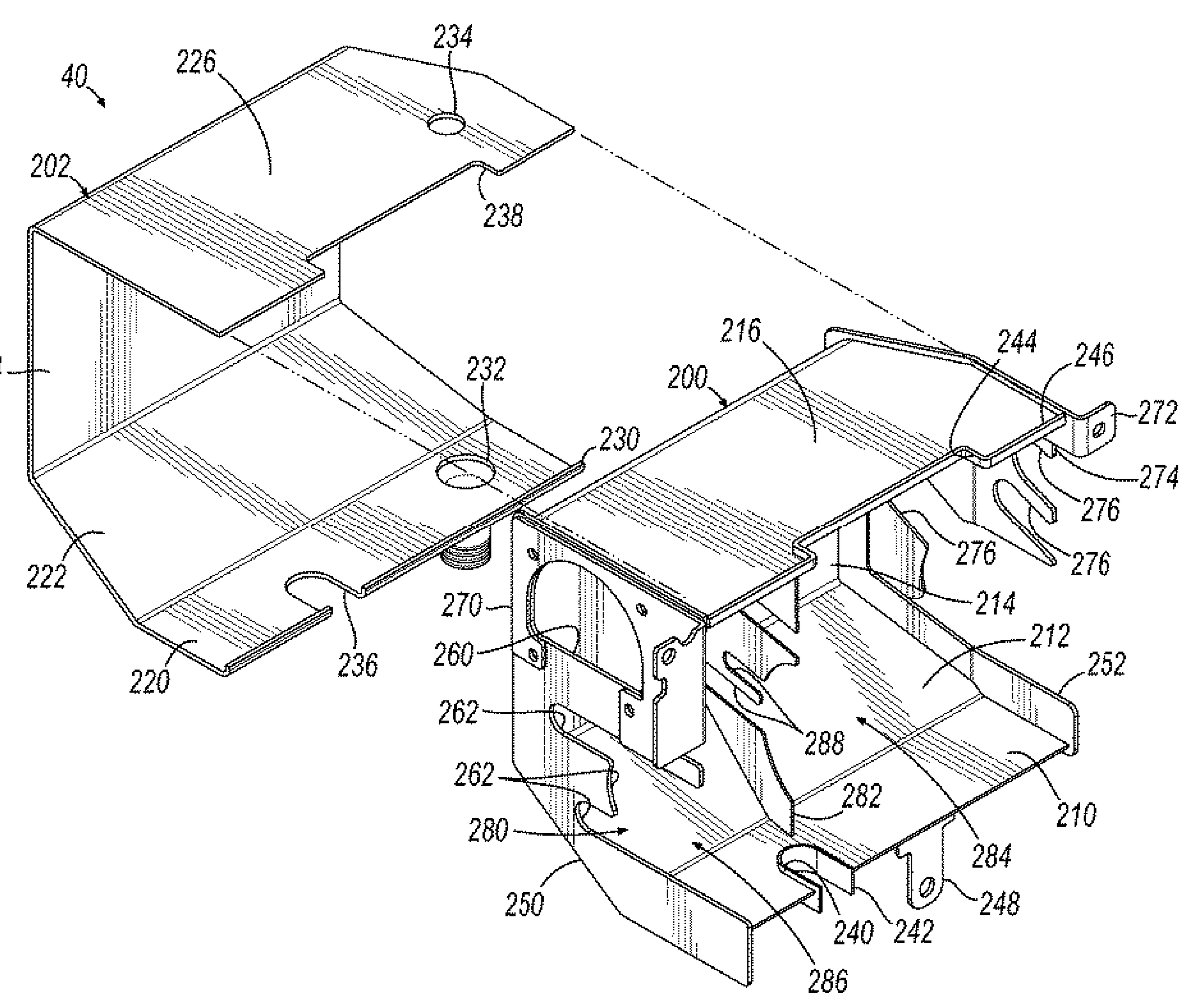
Primary Examiner — Courtney D Heinle
Assistant Examiner — Ryan C Clark
(74) *Attorney, Agent, or Firm* — Wood Herron & Evans LLP

(57) **ABSTRACT**

A heat shield includes an outer jacket including a fluid inlet port and a fluid outlet port, and an inner jacket nested within the outer jacket and spaced apart therefrom to define a fluid passageway therebetween. The fluid passageway is in fluid communication with the fluid inlet port and the fluid outlet port for directing a cooling fluid from the fluid inlet port to the fluid outlet port through the fluid passageway. The inner jacket at least partially defines a main cavity configured to at least partially protect a turbocharger of the marine engine.

20 Claims, 6 Drawing Sheets





Related U.S. Application Data

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(51) **Int. Cl.**

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F01D 25/14	(2006.01)
F02C 7/24	(2006.01)
F01N 3/20	(2006.01)
F01N 3/30	(2006.01)
F01N 3/05	(2006.01)
F01N 11/00	(2006.01)

(52) **U.S. Cl.**

CPC *F05D 2260/231* (2013.01); *Y02T 10/12* (2013.01)

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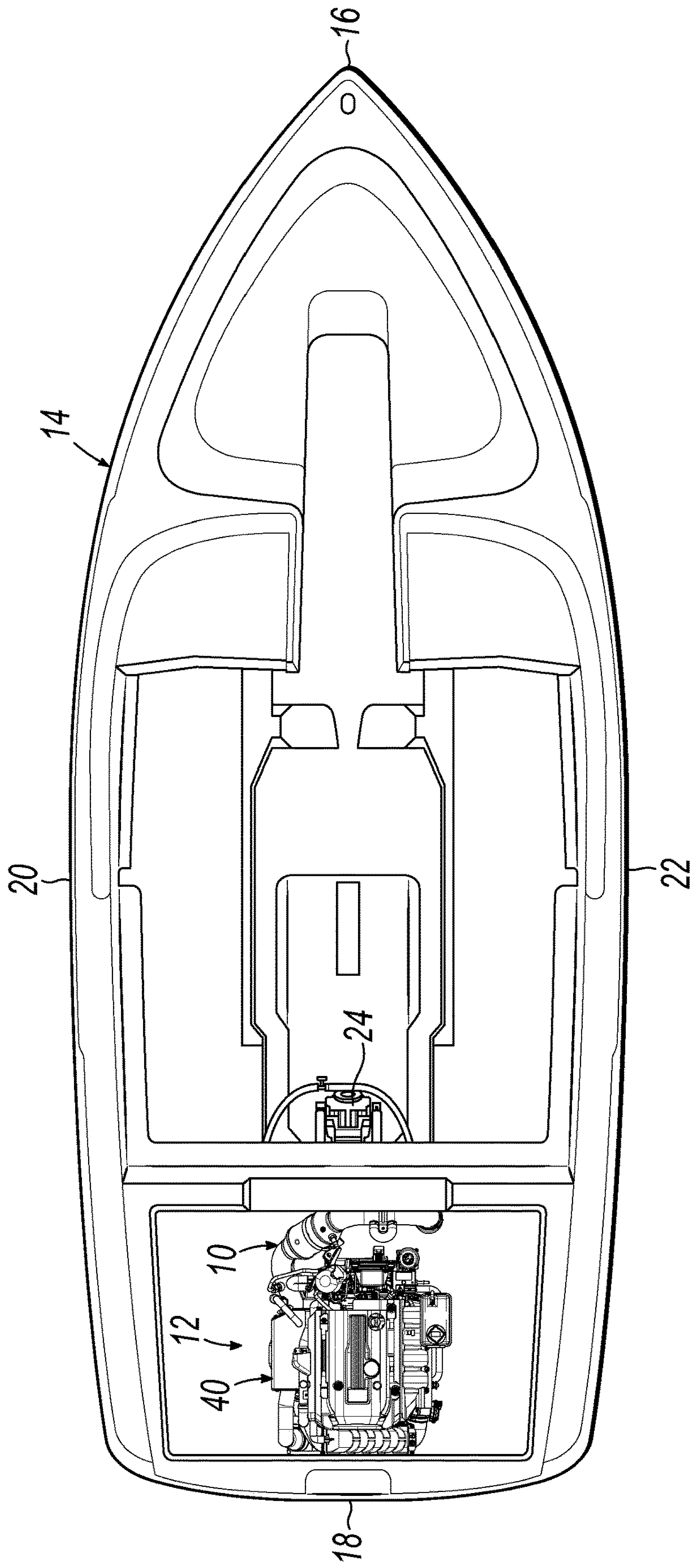

FIG. 1

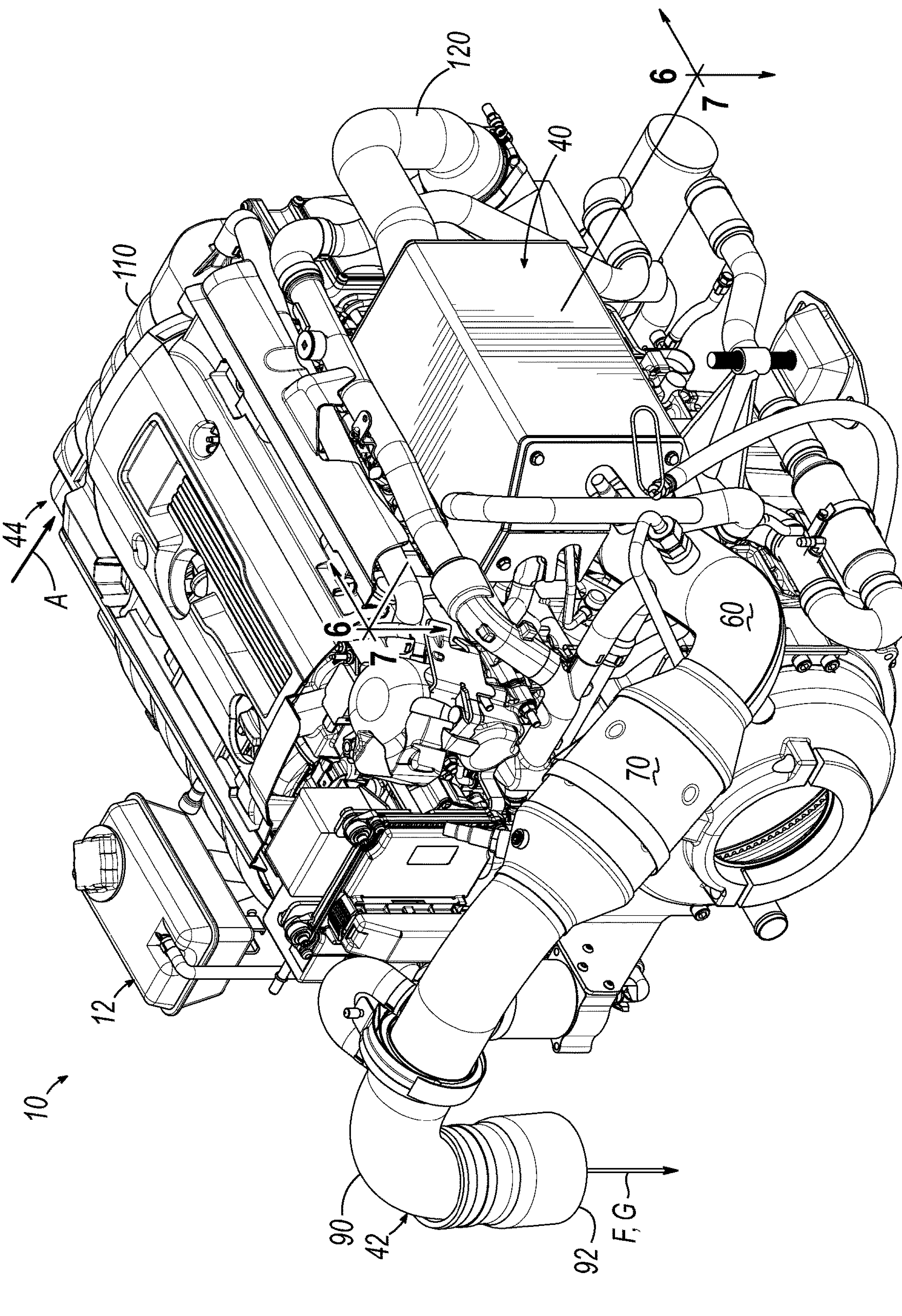

FIG. 2

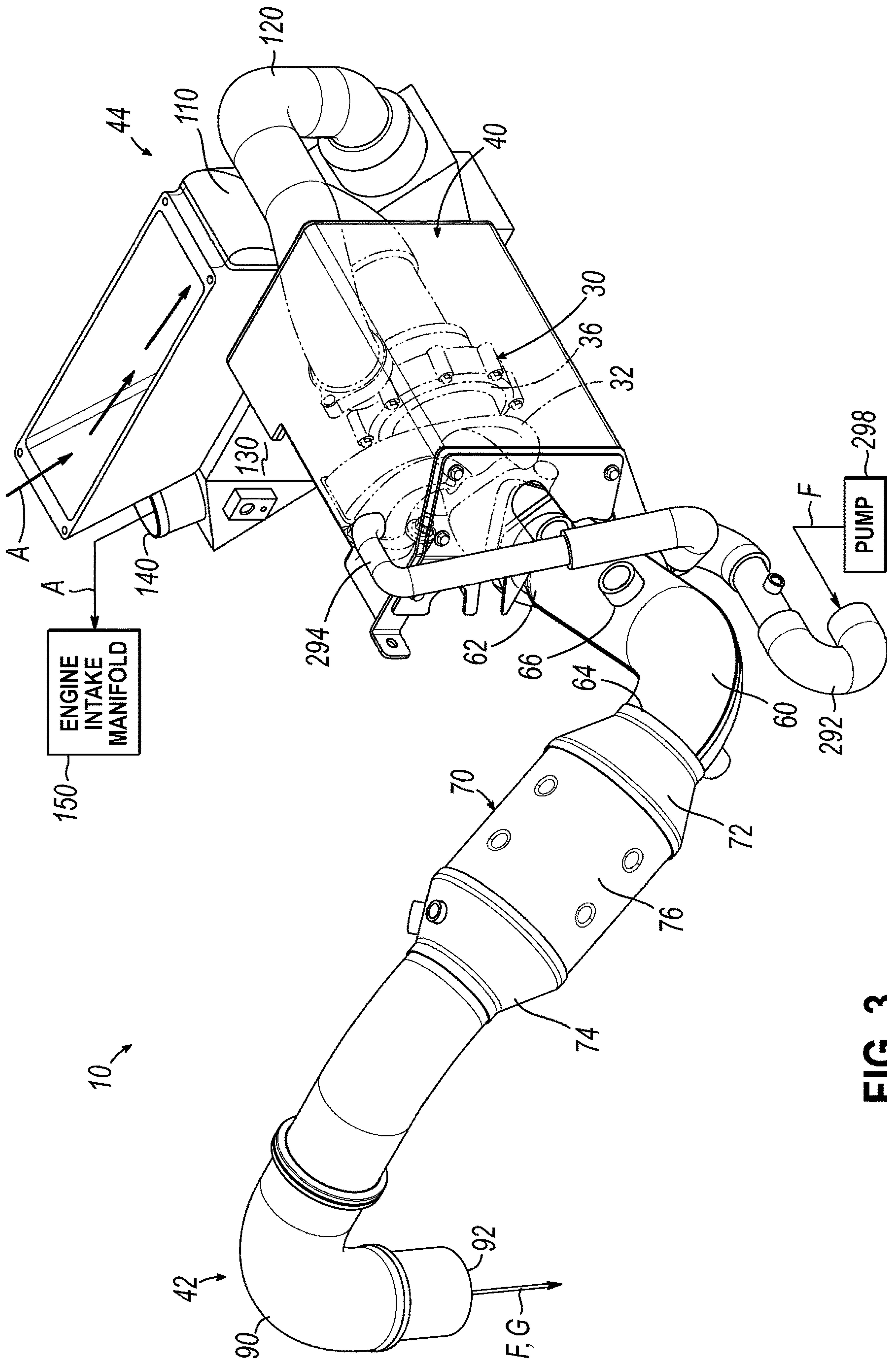
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FIG. 3

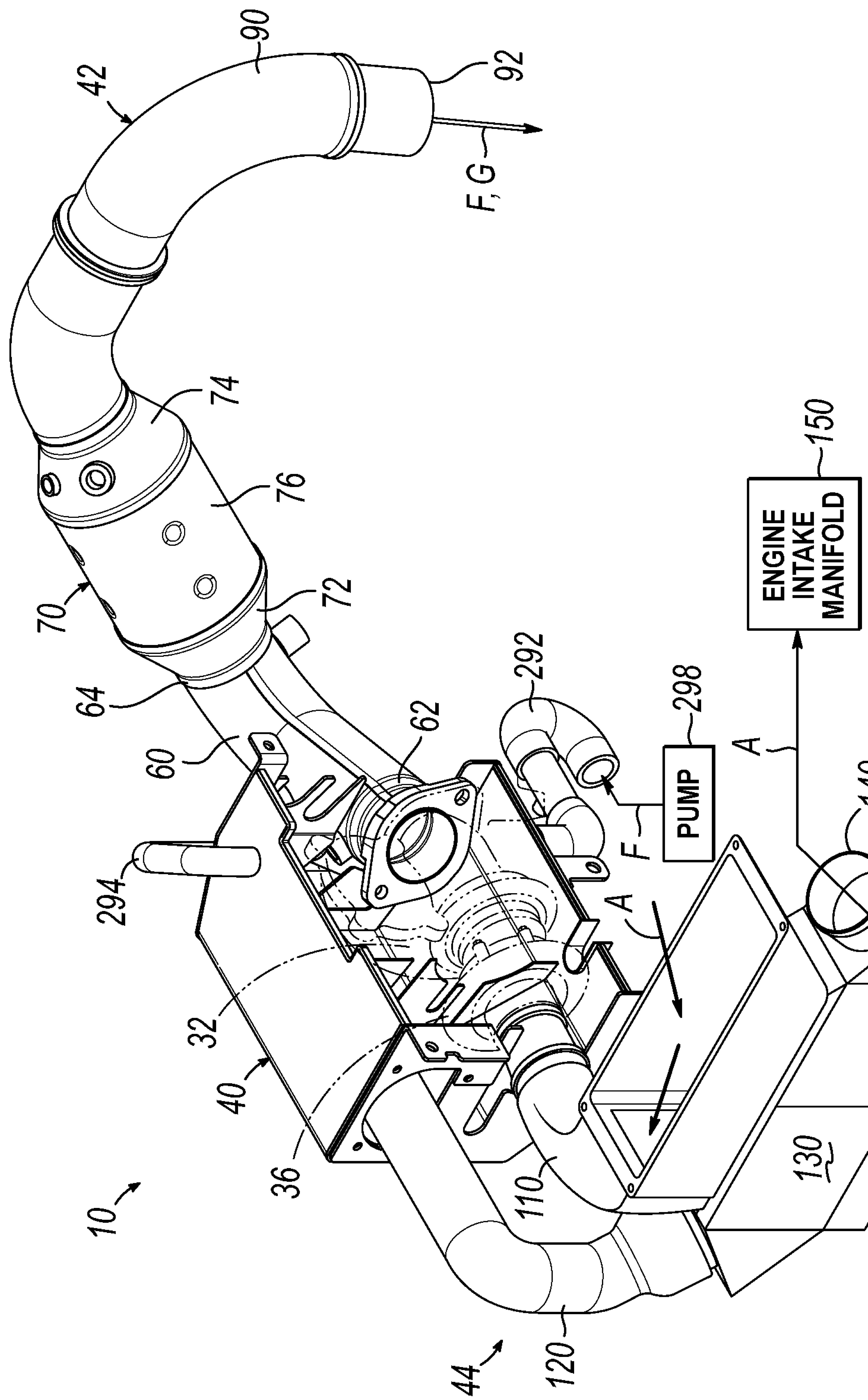
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FIG. 4

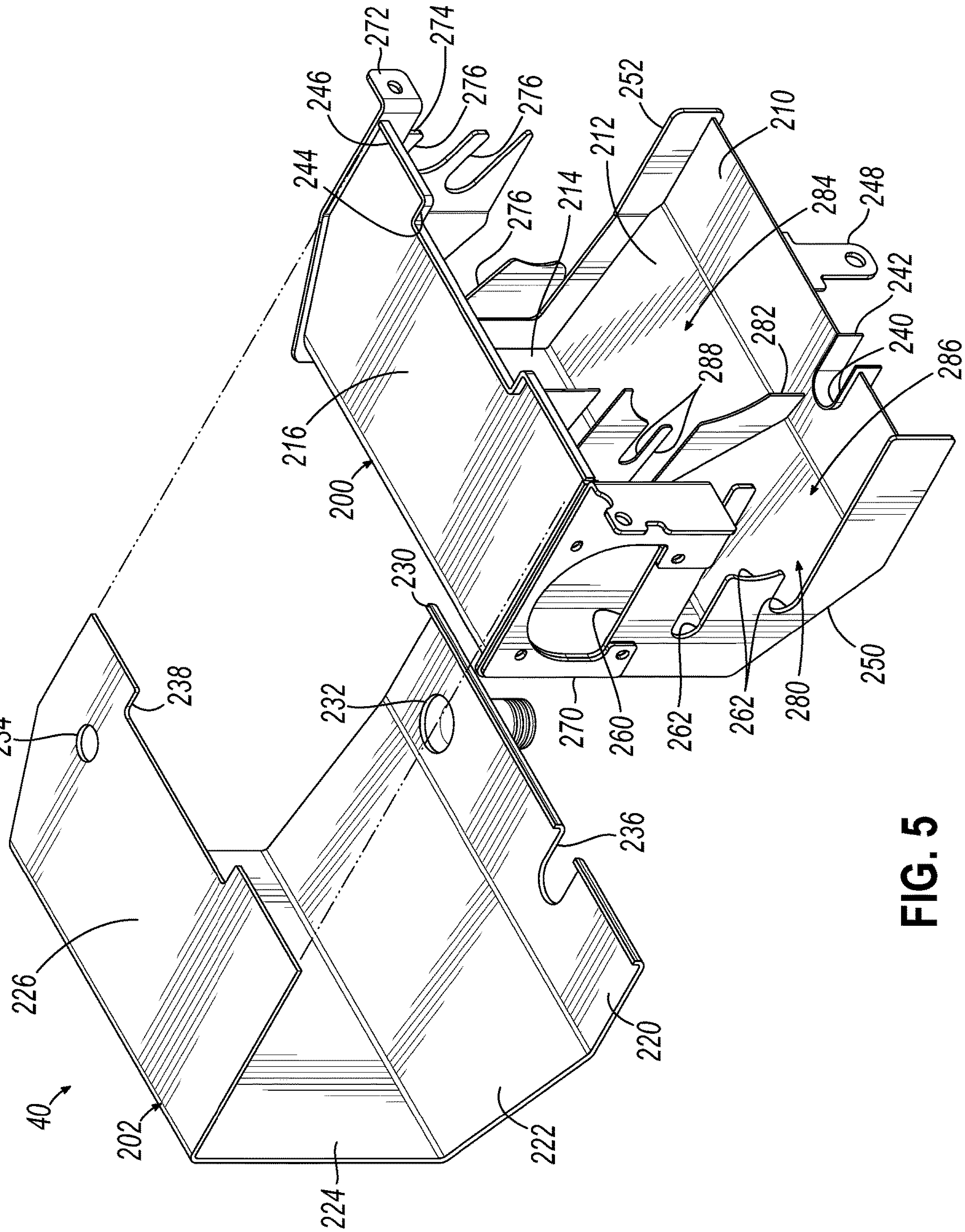
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FIG. 5

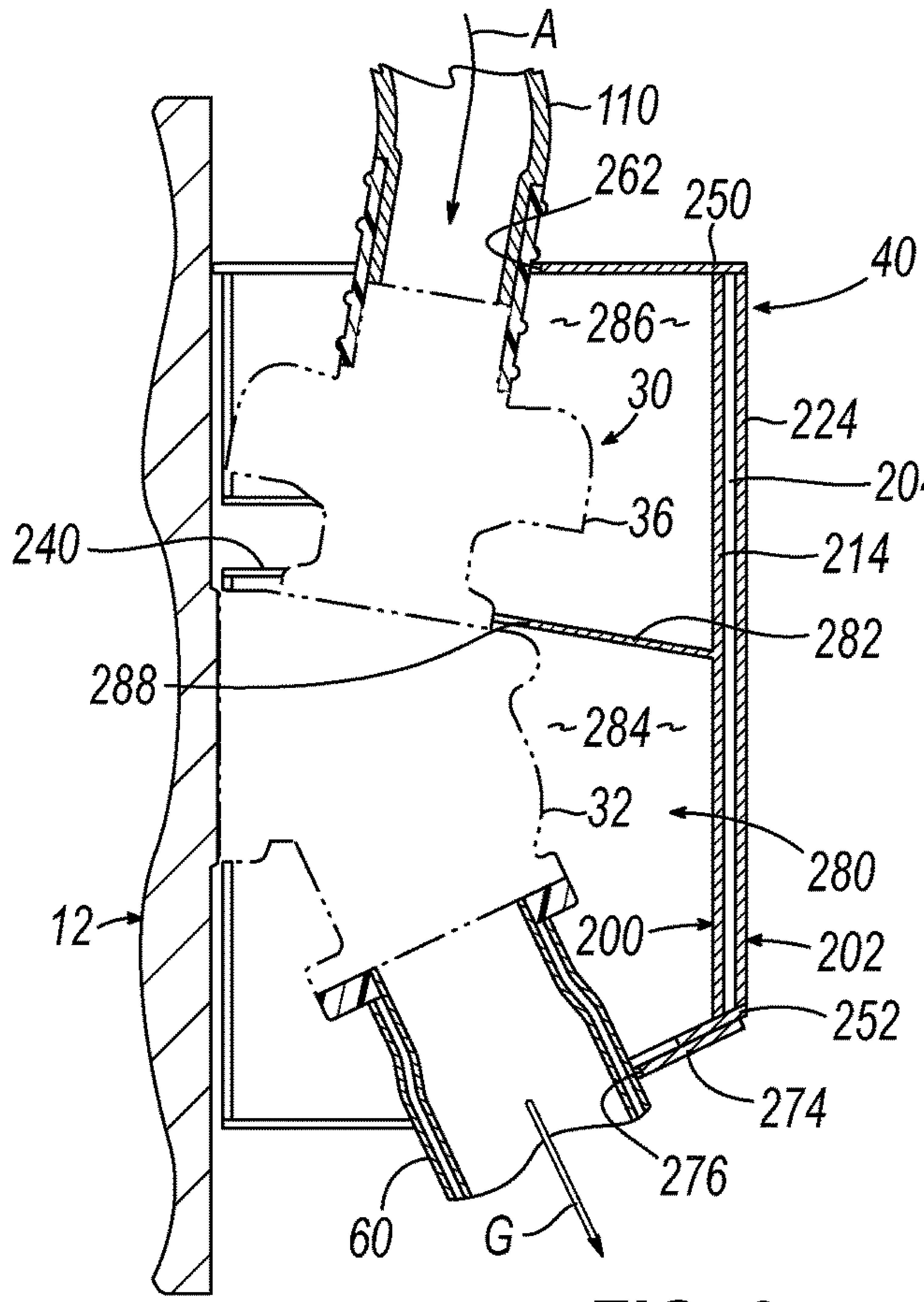
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FIG. 6

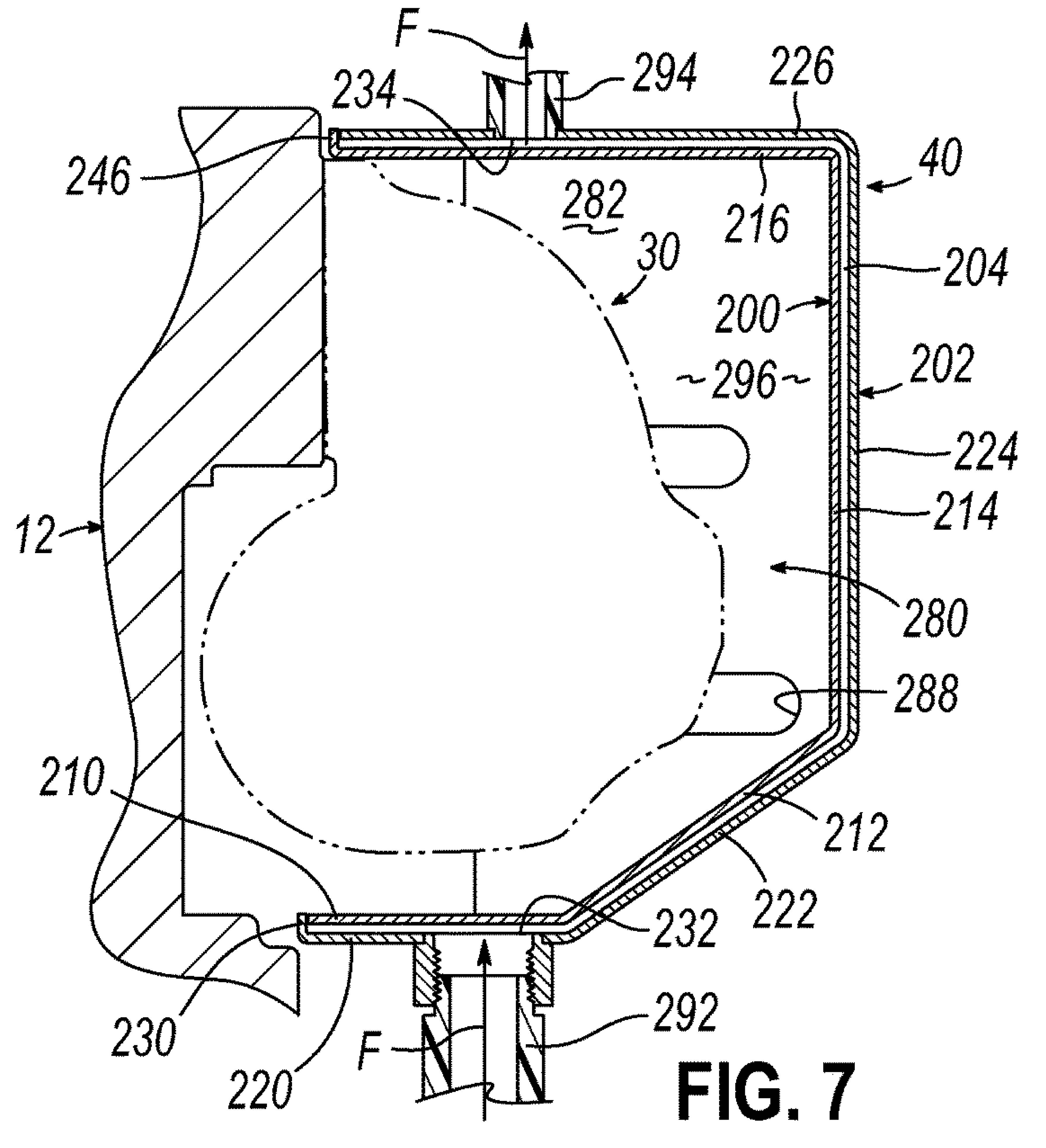
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FIG. 7

HEAT SHIELD FOR A MARINE ENGINE EXHAUST SYSTEM

CROSS REFERENCE TO RELATED APPLICATION

This application is a Continuation of U.S. patent application Ser. No. 16/448,751 filed Jun. 21, 2019 which claims the priority benefit of U.S. Provisional Patent Application Ser. No. 62/804,790 filed on Feb. 13, 2019, the content of which are incorporated by reference in their entirety.

TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to marine engines and, more particularly, to devices and methods for shielding heat associated with forced induction or "boosted" marine engines.

BACKGROUND OF THE INVENTION

Various marine crafts such as motorboats may be outfitted with forced induction or "boosted" marine engines for increasing the efficiency and power output of the engine. Such forced induction marine engines may be equipped with an air intake and exhaust system that includes a turbocharger, for example. One type of turbocharger includes a radial turbine having a rotor and further includes an air compressor such as a centrifugal compressor having an impeller. The turbine may be positioned within the exhaust subsystem and configured to extract energy from the exhaust gases emitted from the engine, while the compressor may be positioned within the air intake subsystem and configured to transfer the extracted energy to fresh air within the compressor. The resulting compressed air is directed to an intake manifold of the engine to provide forced induction to the engine such that the engine may be "boosted." In some cases, the engine may be equipped with multiple turbochargers. For example, the engine may be equipped with a twin turbocharger (e.g., having two turbochargers).

While turbochargers may be effective for their intended purpose of increasing the efficiency and power output of the engine, the turbines and compressors of such turbochargers typically operate at relatively high temperatures. For example, during normal operation the temperature of the turbine may be approximately 1,800° F. and the temperature of the compressor may be approximately 400° F. However, it is typically desirable to prevent the temperature of any surface on or associated with the marine engine that can come into contact with persons or gear from exceeding 200° F. Thus, the presence of one or more turbochargers can undesirably increase the risk that the temperature of such surfaces might exceed the 200° F. limit.

Accordingly, there is a need to address these and other shortcomings associated with forced induction marine engines.

SUMMARY OF THE INVENTION

According to an exemplary embodiment of the invention, a heat shield for at least partially surrounding a turbocharger of a marine engine of a marine craft is provided. The heat shield includes an outer jacket including a fluid inlet port and a fluid outlet port, and an inner jacket nested within the outer jacket and spaced apart therefrom to define a fluid passageway therebetween, the fluid passageway being in fluid communication with the fluid inlet port and the fluid outlet port for directing a cooling fluid from the fluid inlet port to the fluid outlet port through the fluid passageway. The inner jacket at least partially defines a main cavity configured to receive a turbocharger of the marine engine. In one embodiment, the inner jacket is configured to be fixedly coupled to an outer surface of the marine engine and to at least partially encapsulate the turbocharger of the marine engine against the outer surface of the marine engine for thermally isolating the turbocharger from the outer jacket. In addition or alternatively, the heat shield may include first and second sidewalls fixedly coupled to the inner and outer jackets to laterally enclose the fluid passageway. At least one of the first and second sidewalls may include at least one opening for allowing one or more fluid conduits to pass therethrough to the main cavity.

In one embodiment, the inner and outer jackets each include a first portion configured to be positioned below the turbocharger, a second portion configured to be positioned alongside the turbocharger, and a third portion configured to be positioned above the turbocharger. The first portion may oppose the third portion. In addition or alternatively, the fluid passageway may have a generally C-shaped cross section. In one embodiment, the heat shield further includes an inner baffle positioned within the main cavity to divide the main cavity into a turbine chamber configured to receive a turbine of the turbocharger and a compressor chamber configured to receive a compressor of the turbocharger, wherein the inner baffle is configured to thermally isolate the turbine chamber and the compressor chamber from each other. The inner baffle may include an opening configured to allow a shaft of the turbocharger to pass therethrough between the turbine and compressor chambers.

In one embodiment, the inner jacket and the outer jacket include aligned openings configured to allow an oil conduit of the turbocharger to pass therethrough into the main cavity. In addition or alternatively, the cooling fluid may be raw water and the fluid inlet port may be configured to receive the raw water from a body of water in which the marine craft is configured to operate. In another embodiment, the cooling fluid is a synthetic cooling fluid circulated to the fluid passageway through a fluid circuit. In another embodiment, a marine craft includes the heat shield.

In another embodiment, in combination a turbocharger and a heat shield for a marine engine are provided. The combination includes the turbocharger including a turbine configured to extract energy from an exhaust stream, and an air compressor configured to compress ambient air into compressed air. The turbine is operatively coupled to the air compressor to transfer the extracted energy to the ambient air for compressing the ambient air into compressed air. The combination also includes the heat shield including an outer jacket including a fluid inlet port and a fluid outlet port. The heat shield also includes an inner jacket nested within the outer jacket and spaced apart therefrom to define a fluid passageway therebetween, the fluid passageway being in fluid communication with the fluid inlet port and the fluid outlet port for directing a cooling fluid from the fluid inlet port to the fluid outlet port through the fluid passageway. The inner jacket at least partially defines a main cavity, and the turbocharger is positioned within the main cavity.

The combination may further include a marine engine having at least one outer surface, wherein the inner jacket of the heat shield is fixedly coupled to the at least one outer surface of the marine engine to at least partially encapsulate the turbocharger against the at least one outer surface of the marine engine for thermally isolating the turbocharger from the outer jacket. In addition or alternatively, the heat shield may further include an inner baffle positioned within the main cavity to divide the main cavity into a turbine chamber and a compressor chamber, wherein the turbine of the turbocharger is positioned within the turbine chamber and the compressor of the turbocharger is positioned within the compressor chamber, and wherein the inner baffle is configured to thermally isolate the turbine and the compressor from each other. In another embodiment, the combination further includes the cooling fluid, wherein the cooling fluid is raw water and the fluid inlet port is configured to receive the raw water from a body of water in which the marine craft is configured to operate. In another embodiment, the combination further includes the cooling fluid, wherein the cooling fluid is a synthetic cooling fluid circulated to the fluid passageway through a fluid circuit.

In another embodiment, a method of thermally isolating a turbocharger associated with a marine engine of a marine craft from a surrounding environment is provided. The method includes at least partially encapsulating the turbocharger against at least one outer surface of the marine engine with a heat shield including an outer jacket and an inner jacket nested within the outer jacket and spaced apart therefrom to define a fluid passageway therebetween. The method also includes directing a cooling fluid through the fluid passageway. In one embodiment, directing the cooling fluid through the fluid passageway includes receiving the cooling fluid from a body of water in which the marine craft is operating.

Various additional features and advantages of the invention will become more apparent to those of ordinary skill in the art upon review of the following detailed description of the illustrative embodiments taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with the general description given above and the detailed description given below, explain the embodiments of the invention.

FIG. **1** is a top view of a motorboat including an inboard engine, an air intake and exhaust system coupled to the engine, and a heat shield at least partially encapsulating a turbocharger of the exhaust subsystem against the engine, in accordance with an exemplary aspect of the invention.

FIG. **2** is a front perspective view of the air intake and exhaust system of FIG. **1**, showing the engine and various other components associated with the engine.

FIG. **3** is a front schematic view of the air intake and exhaust system of FIG. **2** with various components associated with the engine hidden from view, and showing the heat shield at least partially encapsulating the turbocharger.

FIG. **4** is a rear schematic view of the air intake and exhaust system of FIG. **2** with various components associated with the engine hidden from view, and showing the heat shield at least partially encapsulating the turbocharger.

FIG. **5** is a disassembled view of the heat shield shown in FIG. **2**.

FIG. **6** is a cross sectional view of the heat shield shown in FIG. **2**, taken along section line **6-6** in FIG. **2**.

FIG. **7** is a cross sectional view of the heat shield shown in FIG. **2**, taken along section line **7-7** in FIG. **2**.

DETAILED DESCRIPTION

Referring now to FIG. **1**, an air intake and exhaust system **10** is shown mounted to a forced induction or "boosted" marine engine **12** within a marine craft such as a motorboat **14**. The motorboat **14** includes a bow **16**, a stern **18**, a port side **20**, and a starboard side **22**. The engine **12** is shown mounted in an "inboard" configuration and is coupled to a V-drive transmission **24** that drives a propeller shaft and propeller (not shown) to rotate, which propels the motorboat **14** through the water. As shown in FIG. **3**, the illustrated forced induction engine **12** is equipped with a turbocharger **30** including a radial turbine **32** and an air compressor such as a centrifugal compressor **36** (FIGS. **3** and **4**) for increasing the efficiency and power output of the engine **12**. As described in greater detail below, the turbocharger **30** is at least partially enclosed by an exemplary heat shield **40** according to an aspect of the invention to restrict the transfer of heat from the turbocharger **30** to surfaces which may come into contact with persons or gear carried by the motorboat **14**.

Referring now to FIGS. **2-4**, the exemplary heat shield **40** is shown within the air intake and exhaust system **10** in greater detail, with various components associated with the engine **12** being hidden from view in FIGS. **3** and **4**. In the embodiment shown, the air intake and exhaust system **10** includes an exhaust subsystem **42** and an air intake subsystem **44**.

The exhaust subsystem **42** may generally include at least one exhaust manifold (not shown) that couples to at least one bank of cylinders of the engine **12**. The at least one exhaust manifold may include a suitable number of exhaust inlet ports, each aligned in fluid communication with and receiving hot exhaust gases G expelled from a respective cylinder of the engine **12**.

As best shown in FIGS. **3** and **4**, the illustrated exhaust subsystem **42** further includes the turbine **32** of the turbocharger **30**. More particularly, the turbine **32** is positioned downstream of and in fluid communication with the exhaust manifold for receiving exhaust gases G expelled therefrom. The turbine **32** is configured to extract energy from the flow of exhaust gases G which may then be transferred to the compressor **36**. For example, a rotor (not shown) may be rotatably mounted within the turbine **32** so as to be driven by the exhaust gases G passing therethrough. The rotor of the turbine **32** may be operatively coupled to an impeller (not shown) of the compressor **36** which may be rotatably mounted within the compressor **36** such that rotation of the rotor may cause a corresponding rotation of the impeller. In this manner, the turbine **32** may extract energy from the exhaust gases G and the compressor **36** may transfer the extracted energy to fresh air A within the compressor **36**, as described in greater detail below.

An exhaust conduit **60** is positioned downstream of and in fluid communication with the turbine **32** for receiving exhaust gases G expelled therefrom. The exhaust conduit **60** includes an exhaust inlet **62** positioned proximate to the turbine **32** and an exhaust outlet **64** positioned distal from the turbine **32**. The illustrated exhaust conduit **60** also includes a secondary air inlet **66** positioned between the exhaust inlet and outlet **62**, **64**, the purpose of which is described in greater detail in U.S. Provisional Patent Application Ser. No. 62/804,790, filed on Feb. 13, 2019, the content of which is incorporated by reference in its entirety.

A catalytic converter assembly **70** is positioned downstream of and in fluid communication with the exhaust conduit **60** for receiving at least exhaust gases G expelled therefrom. The catalytic converter assembly **70** includes inlet and outlet cone portions **72**, **74** that taper from an intermediate portion **76** having an enlarged diameter for accommodating a catalyst brick or element (not shown) housed therein. The catalyst element is configured to remove toxic pollutants from the exhaust gases G.

The exhaust subsystem **42** also includes a tailpipe **90** positioned downstream of and in fluid communication with the catalytic converter assembly **70** for receiving at least the exhaust gases G expelled therefrom. The tailpipe **90** includes an exhaust subsystem outlet **92** for directing at least the exhaust gases G out of the exhaust subsystem **42** to an external environment.

The air intake subsystem **44** may generally include an air intake (not shown) having at least one air intake subsystem inlet for receiving fresh ambient air A from the external environment to be at least primarily directed to the engine **12** for combustion purposes, for example. An air intake duct **110** may be positioned downstream of and in fluid communication with the air intake for receiving the fresh ambient air A therefrom.

As best shown in FIGS. **3** and **4**, the illustrated air intake subsystem **44** further includes the compressor **36** of the turbocharger **30**. More particularly, the compressor **36** is positioned downstream of and in fluid communication with the air intake duct **110** for receiving the fresh ambient air A therefrom. The compressor **36** of the turbocharger **30** is configured to transfer energy extracted from the flow of exhaust gases G by the turbine **32**, for example, to the ambient air A. In this regard, the impeller rotatably mounted within the compressor **36** may be configured to compress the air A via rotation of the impeller corresponding to rotation of the rotor of the turbine **32** caused by the exhaust gases G passing through the turbine **32**.

A compressor outlet conduit **120** is positioned downstream of and in fluid communication with the compressor **36** for directing compressed air A therefrom to an intercooler **130** positioned downstream of and in fluid communication with the compressor outlet conduit **120**. An intercooler outlet conduit **140** is positioned downstream of and in fluid communication with the intercooler **130** for directing at least a portion of the compressed air A to an intake manifold **150** of the engine **12**. The interface between the intercooler outlet conduit **140** and the intake manifold may define a primary air injection location into the engine **12**. Thus, the compressor **36** of the turbocharger **30** is fluidly coupled to the intake manifold of the engine **12** for directing at least a portion of the compressed air A to the intake manifold of the engine **12** to provide forced induction to the engine **12** such that the engine **12** may be "boosted."

In one embodiment, the intercooler outlet conduit **140** may include a secondary air outlet, a secondary air injection conduit may extend from the secondary air outlet to the secondary air inlet **66** of the exhaust conduit **60** and thus may bypass the engine **12** entirely, and a valve having a closed position and at least one open position may be positioned in-line with the secondary air injection conduit for selectively placing the intercooler outlet conduit **140** and exhaust conduit **60** in fluid communication with each other such that a second portion of the compressed air A may be directed from the intercooler outlet conduit **140** to the exhaust conduit **60** when the valve is in the open position (not shown). Thus, the secondary air inlet **66** may define a secondary air injection location into the exhaust stream G. In this manner, the compressor **36** of the turbocharger **30** may be selectively fluidly coupled to the catalytic converter assembly **70** for selectively directing a second portion of the compressed air A into the exhaust gas stream G at or upstream from the catalytic converter assembly **70** for assisting in catalysis, as described in greater detail in U.S. Provisional Patent Application Ser. No. 62/804,790, filed on Feb. 13, 2019, the content of which is incorporated by reference in its entirety.

In the embodiment shown, the turbocharger **30** is at least partially enclosed by the exemplary heat shield **40**. More particularly, the heat shield **40** is mounted to an outer surface of the engine **12** to at least partially envelope or encapsulate the turbocharger **30** against the engine **12** for thermally isolating the turbocharger **30** from the surrounding environment.

In this regard, and referring now to FIGS. **5-7**, the illustrated heat shield **40** includes an inner jacket **200** and an outer jacket **202**. As shown, the inner and outer jackets **200**, **202** may have a same or substantially similar cross sectional shape and may be relatively sized such that the inner jacket **200** may be nested within the outer jacket **202** while being spaced apart therefrom to at least partially define a fluid passageway **204** therebetween. In the embodiment shown, the inner jacket **200** includes a generally horizontal first wall **210**, a generally sloping second wall **212**, a generally vertical third wall **214**, and a generally horizontal fourth wall **216** opposite the first wall **210**, respectively, such that the inner jacket **200** may have a generally C-shaped cross section. Similarly, the outer jacket **202** includes a generally horizontal first wall **220**, a generally sloping second wall **222**, a generally vertical third wall **224**, and a generally horizontal fourth wall **226** opposite the first wall **220**, respectively, such that the outer jacket **202** may also have a generally C-shaped cross section. The inner and outer jackets **200**, **202** may be constructed of stainless steel, for example, or any other suitable material

The illustrated outer jacket **202** includes a lip **230** extending upwardly from a terminal end of the first wall **220** thereof to close off the respective end of the fluid passageway **204**. As shown, the first and fourth walls **220**, **226** of the outer jacket **202** include a fluid inlet port **232** and a fluid outlet port **234**, respectively, each configured to be in fluid communication with the fluid passageway **204** as described below. In the embodiment shown, the first wall **220** of the outer jacket **202** also includes an opening in the form of an outer oil access recess **236** for allowing an oil conduit (not shown) to pass therethrough and the fourth wall **226** of the outer jacket **202** also includes an elongate notch **238** for accommodating a portion of the engine **12**, for example.

The illustrated inner jacket **200** includes an opening in the form of an inner oil access recess **240** configured to be aligned with the outer oil access recess **236** of the outer jacket **202** for allowing the oil conduit to pass therethrough, such as for lubricating a shaft operatively coupling the rotor (not shown) of the turbine **32** to the impeller (not shown) of the compressor **36**. In the embodiment shown, a generally U-shaped barrier **242** is configured to abut the peripheries of the inner and outer oil access recesses **240**, **236** to close off the fluid passageway **204** therefrom. In addition, the fourth wall **216** of the inner jacket **200** includes an elongate notch **244** configured to be aligned with the elongate notch **238** of the outer jacket **202** for accommodating a portion of the engine **12**, for example, and an elongate barrier **246** is positioned between the inner and outer jackets **200**, **202** at the terminal ends of the fourth walls **216**, **226** thereof to close off the respective end of the fluid passageway **204**. In the embodiment shown, a downwardly-extending tab **248** is provided at the terminal end of the first wall **210** of the inner jacket **200** for fixedly coupling the inner jacket **200** to an outer surface of the engine **12**, for example.

As shown, the heat shield **40** also includes first and second sidewalls **250**, **252**. The sidewalls **250**, **252** may each have a profile generally corresponding to the cross sectional shape of the jackets **200**, **202** and may be sized relative thereto to close off the fluid passageway **204** at the sides thereof such that the fluid passageway **204** is laterally bounded or enclosed by the sidewalls **250**, **252**. For example, the sidewalls **250**, **252** may each have a generally C-shaped profile. In any event, the sidewalls **250**, **252** are fixedly coupled to each of the jackets **200**, **202** at their respective locations, such as by welding, in order to provide a fluid-tight connection therebetween. In the embodiment shown, the first sidewall **250** includes openings in the form of an aperture **260** and a first multi-stage recess **262** for allowing various components, such as conduits associated with the turbocharger **30**, to pass therethrough. For example, the aperture **260** in the first sidewall **250** may be configured for allowing the compressor outlet conduit **120** to pass therethrough, and the first multi-stage recess **262** in the first sidewall **250** may be configured for allowing at least the air intake duct **110** to pass therethrough, for routing air A to and from the compressor **36** of the turbocharger **30**, as shown in FIG. **6**.

First and second brackets **270**, **272** are configured to fixedly couple the first and second sidewalls **250**, **252** to an outer surface of the engine **12**, respectively. In the embodiment shown, the first bracket **270** is configured to be removably coupled to the first sidewall **250** above the first multi-stage recess **262** and is sized and configured to partially surround the aperture **260** in the first sidewall **250** to avoid interfering with the passage of the compressor outlet conduit **120** through the aperture **260** and to avoid interfering with the passage of the air intake duct **110** through the first multi-stage recess **262**. The illustrated second bracket **272** is integrally formed together with the second sidewall **252** as a unitary piece.

As shown in FIG. **5**, a cover **274** is removably coupled to the second sidewall **252** and includes an opening in the form of a second multi-stage recess **276** for allowing various components, such as conduits associated with the turbocharger **30**, to pass therethrough. For example, as shown in FIG. **6**, the second multi-stage recess **276** in the cover **274** may be configured for allowing at least the exhaust conduit **60** to pass therethrough, for routing exhaust gases G from the turbine **32** of the turbocharger **30**. Various other configurations of the sidewalls **250**, **252**, respective brackets **270**, **272**, and/or cover **274** may be used as may be desired. The sidewalls **250**, **252**, brackets **270**, **272**, and/or cover **274** may be constructed of stainless steel, for example, or any other suitable material.

As best shown in FIGS. **6** and **7**, the inner jacket **200**, sidewalls **250**, **252**, and at least one outer surface of the engine **12** collectively define a main cavity **280** for at least partially encapsulating the turbocharger **30**. As shown in FIG. **6**, an inner baffle **282** welded or otherwise secured to the inner jacket **200** is positioned within the main cavity **280** between the turbine **32** and the compressor **36** to divide the main cavity **280** into a turbine chamber **284** for receiving the turbine **32** and a compressor chamber **286** for receiving the compressor **36**. The inner baffle **282** may assist in thermally isolating the turbine chamber **284** and the compressor chamber **286** from each other. In this regard, the inner baffle **282** may inhibit heat transfer between the turbine chamber **284** and the compressor chamber **286**, and thus between the turbine **32** and the compressor **36** of the turbocharger **30**. For example, during normal operation the temperature of the turbine **32** may be approximately 1,800° F. while the temperature of the compressor **36** may be approximately 400° F. The illustrated inner baffle **282** includes an opening in the form of a third multi-stage recess **288** for allowing various components, such as conduits associated with the turbocharger **30**, to extend therethrough between the turbine chamber **284** and the compressor chamber **286**. For example, the third multi-stage recess **288** in the inner baffle **282** may be configured for allowing at least a shaft operatively coupling the rotor of the turbine **32** to the impeller of the compressor **36** to pass therethrough. Various other configurations of the inner baffle **282** may be used as may be desired. The inner baffle **282** may be constructed of stainless steel, for example, or any other suitable material.

As best shown in FIG. **7**, the inner and outer jackets **200**, **202** are spaced apart from each other to define the fluid passageway **204** which extends or wraps at least partially about the turbocharger **30**. For example, the first walls **210**, **220** of the inner and outer jackets **200**, **202**, respectively, are positioned below the turbocharger **30**, the second walls **212**, **222** extend from below the turbocharger **30** to alongside the turbocharger **30**, the third walls **214**, **224** are positioned alongside the turbocharger **30**, and the fourth walls **216**, **226** are positioned above the turbocharger **30**. In this manner, the illustrated fluid passageway **204** extends from a position below the turbocharger **30**, alongside the turbocharger **30**, to a position above the turbocharger **30** such that the fluid passageway **204** has a generally C-shaped cross section and substantially surrounds the bottom of the turbocharger **30**, the side of the turbocharger **30** opposite the engine **12**, and the top of the turbocharger **30**. Thus, the fluid passageway **204** is substantially between the turbocharger **30** and any persons or gear carried by the motorboat **14** which might otherwise be capable of contacting the turbocharger **30**.

As shown in FIG. **7**, a cooling fluid F may be directed from the fluid inlet port **232**, through the fluid passageway **204**, to the fluid outlet port **234**. Cooling fluid F may be supplied to the fluid inlet port **232** by a cooling fluid inlet conduit **292** and may be discharged from the fluid outlet port **234** into a cooling fluid outlet conduit **294**, for example. See FIGS. **4** and **7**.

By directing the cooling fluid F through the passageway **204** at least partially about the turbocharger **30** and substantially between the turbocharger **30** and any persons or gear carried by the motorboat **14**, the heat shield **40** may assist in thermally isolating the main cavity **280** from the surrounding environment such as the exterior of the heat shield **40**. In this regard, the cooling fluid F may inhibit heat transfer between the main cavity **280** and the outer jacket **202** of the heat shield **40**, and thus between the turbocharger **30** and the exterior of the heat shield **40**. For example, the surface temperature of the outer jacket **202** may remain at or below 200° F. while the temperature of the turbine **32** may be approximately 1,800° F. and while the temperature of the compressor **36** may be approximately 400° F.

In the embodiment shown, the turbocharger **30** is spaced apart from the inner jacket **200** of the heat shield **40** by an air gap **296**. In other words, the turbocharger **30** is not in direct physical contact with the inner jacket **200** of the heat shield **40**. The air gap **296** may allow the temperature of the exhaust gases G in the turbine **32** of the turbocharger **30** to be substantially unaffected by the relatively low temperature of cooling fluid F flowing through the passageway **204** so that the temperature of the exhaust gases G may remain relatively high, such as for efficient emissions reduction. For example, the air gap **296** may be between approximately ½ inch and approximately 1 inch.

In one embodiment, the cooling fluid F may be water. For example, the cooling fluid inlet conduit **292** may receive "raw" water drawn from the body of water (e.g., lake or ocean) in which the motorboat **14** is operating via a water pump **298**. See FIG. **4**. Any other suitable cooling fluid F may be used, such as a synthetic coolant mixture (e.g., glycol), which may be circulated to the fluid passageway **204** through a fluid circuit (not shown) including the fluid inlet and outlet conduits **292**, **294**. The cooling fluid F may be used for other cooling purposes associated with the engine **12**, such as for cooling the compressed air A within the intercooler **130** and/or for cooling the outer surfaces of the exhaust subsystem **42**, before and/or after being directed through the fluid passageway **204** of the heat shield **40**. For example, the fluid outlet conduit **294** may direct the cooling fluid F to one or more cooling jackets surrounding the catalytic converter assembly **70** similar to the cooling jackets described in U.S. Pat. No. 9,957,863, the content of which is incorporated by reference in its entirety. The cooling fluid F may flow through such cooling jackets in a direction parallel to the flow of the exhaust gases G, without contacting the exhaust gases G. Ultimately, the cooling fluid F may be combined with the exhaust gases G downstream of the catalytic converter assembly **70** and ejected together with the exhaust gases G through the exhaust subsystem outlet **92** to the environment.

In this manner, the heat shield **40** may effectively thermally isolate the turbocharger **30** from the surrounding exterior environment. In one embodiment, the heat shield **40** may allow a conventional automotive turbocharged engine to be marinized without recasting the turbocharger of such an engine with an integral water jacket. In other words, a preexisting automotive turbocharged engine may be easily retrofitted with the heat shield **40** so as to be suitable for use in marine applications.

While the turbine **32** and compressor **36** of the turbocharger **30** have been shown and described as a radial turbine and centrifugal compressor, respectively, it will be appreciated that the turbine **32** and compressor **36** may be configured in any other suitable manner for compressing the air A by extracting energy from the exhaust gases G. For example, the turbine **32** and/or compressor **36** may be axially configured. Moreover, while the illustrated forced induction engine **12** is equipped with the turbocharger **30** including the turbine **32** and the compressor **36**, other suitable forced induction devices may be used. For example, the engine **12** may be equipped with a supercharger having an air compressor driven by a belt connected to a crankshaft (not shown) of the engine **12**, rather than by the illustrated turbine **32** and exhaust stream G. In such cases, the heat shield **40** may at least partially enclose the compressor. In other embodiments, the engine **12** may be equipped with multiple turbochargers and/or superchargers. For example, the engine **12** may be equipped with a twin turbocharger (e.g., having two turbochargers **30**) or twin supercharger (e.g., having two superchargers). In such cases, multiple heat shields **40** corresponding to the number of turbochargers or superchargers may be used, for example.

The physical configurations of the air intake and exhaust system **10** as shown in the accompanying drawings are merely exemplary. The components of the air intake and exhaust systems **10** may be configured and arranged in any suitable manner. For example, the various conduits described herein may extend for any desired length and with any configuration suitable for directing the exhaust gases G, air A, and cooling fluid F to the respective destinations. For example, the tailpipe **90** may extend externally through a transom or a side of the hull of the motorboat **14**, and may include an exhaust tip (not shown) of various types known in the art, for example.

While the present invention has been illustrated by the description of specific embodiments thereof, and while the embodiments have been described in considerable detail, it is not intended to restrict or in any way limit the scope of the appended claims to such detail. The various features discussed herein may be used alone or in any combination. Additional advantages and modifications will readily appear to those skilled in the art. The invention in its broader aspects is therefore not limited to the specific details, representative apparatus and methods and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the scope of the general inventive concept.

What is claimed is:

1. A heat shield for at least partially surrounding a turbocharger of a marine engine of a marine craft, the heat shield comprising:
- an outer jacket including a fluid inlet port and a fluid outlet port;
- an inner jacket nested within the outer jacket and spaced apart therefrom to define a fluid passageway therebetween, the fluid passageway being in fluid communication with the fluid inlet port and the fluid outlet port for directing a cooling fluid from the fluid inlet port to the fluid outlet port through the fluid passageway,
- wherein the inner jacket at least partially defines a main cavity configured to receive the turbocharger of the marine engine; and
- an inner baffle positioned within the main cavity to divide the main cavity into a turbine chamber configured to receive a turbine of the turbocharger and a compressor chamber configured to receive a compressor of the turbocharger.

2. The heat shield of claim **1**, wherein the inner jacket is configured to be fixedly coupled to an outer surface of the marine engine and to at least partially encapsulate the turbocharger of the marine engine against the outer surface of the marine engine for thermally isolating the turbocharger from the outer jacket.

3. The heat shield of claim **1**, further comprising:
- first and second sidewalls fixedly coupled to the inner and outer jackets to laterally enclose the fluid passageway.

4. The heat shield of claim **3**, wherein at least one of the first and second sidewalls includes at least one opening for allowing one or more fluid conduits to pass therethrough to the main cavity.

5. The heat shield of claim **1**, wherein the inner and outer jackets each include a first portion configured to be positioned below the turbocharger, a second portion configured to be positioned alongside the turbocharger, and a third portion configured to be positioned above the turbocharger.

6. The heat shield of claim **5**, wherein the first portion opposes the third portion.

7. The heat shield of claim **1**, wherein the fluid passageway has a generally C-shaped cross section.

8. The heat shield of claim **1**, wherein the inner baffle is configured to thermally isolate the turbine chamber and the compressor chamber from each other.

9. The heat shield of claim **1**, wherein the inner baffle includes an opening configured to allow a shaft of the turbocharger to pass therethrough between the turbine and compressor chambers.

10. A heat shield for at least partially surrounding a turbocharger of a marine engine of a marine craft, the heat shield comprising:
- an outer jacket including a fluid inlet port and a fluid outlet port;

an inner jacket spaced apart from the outer jacket to define a fluid passageway therebetween, the fluid passageway being in fluid communication with the fluid inlet port and the fluid outlet port for directing a cooling fluid from the fluid inlet port to the fluid outlet port through the fluid passageway,

wherein the inner jacket at least partially defines a main cavity configured to receive the turbocharger of the marine engine and wherein the inner jacket and the outer jacket include openings configured to allow an oil conduit of the turbocharger to pass therethrough into the main cavity.

11. The heat shield of claim **10**, wherein the cooling fluid is raw water and the fluid inlet port is configured to receive the raw water from a body of water in which the marine craft is configured to operate.

12. The heat shield of claim **10**, wherein the cooling fluid is a synthetic cooling fluid circulated to the fluid passageway through a fluid circuit.

13. A marine craft including the heat shield of claim **1**.

14. In combination a turbocharger and a heat shield for a marine engine, the combination comprising:

the turbocharger including:

a turbine configured to extract energy from an exhaust stream; and

an air compressor configured to compress ambient air into compressed air,

wherein the turbine is operatively coupled to the air compressor to transfer the extracted energy to the ambient air for compressing the ambient air into compressed air; and

the heat shield including:

an outer jacket including a fluid inlet port and a fluid outlet port; and

an inner jacket nested within the outer jacket and spaced apart therefrom to define a fluid passageway therebetween, the fluid passageway being in fluid communication with the fluid inlet port and the fluid outlet port for directing a cooling fluid from the fluid inlet port to the fluid outlet port through the fluid passageway,

wherein the inner jacket at least partially defines a main cavity, and wherein the turbocharger is positioned within the main cavity and wherein the heat shield further includes an inner baffle positioned within the main cavity to divide the main cavity into a turbine chamber and a compressor chamber, wherein the turbine of the turbocharger is positioned within the turbine chamber and the air compressor of the turbocharger is positioned within the compressor chamber.

15. The combination of claim **14**, further comprising:

a marine engine having at least one outer surface, wherein the inner jacket of the heat shield is fixedly coupled to the at least one outer surface of the marine engine to at least partially encapsulate the turbocharger against the at least one outer surface of the marine engine for thermally isolating the turbocharger from the outer jacket.

16. The combination of claim **14**, wherein the inner baffle is configured to thermally isolate the turbine and the air compressor from each other.

17. The combination of claim **14**, further comprising:

the cooling fluid, wherein the cooling fluid is raw water and the fluid inlet port is configured to receive the raw water from a body of water in which the marine craft is configured to operate.

18. The combination of claim **14**, further comprising:

the cooling fluid, wherein the cooling fluid is a synthetic cooling fluid circulated to the fluid passageway through a fluid circuit.

19. A method of thermally isolating a turbocharger associated with a marine engine of a marine craft from a surrounding environment, the method comprising:

at least partially encapsulating the turbocharger against at least one outer surface of the marine engine with a heat shield including an outer jacket and an inner jacket nested within the outer jacket and spaced apart therefrom to define a fluid passageway therebetween;

separating a turbine of the turbocharger from a compressor of the turbocharger by an inner baffle positioned within a main cavity of the turbocharger; and

directing a cooling fluid through the fluid passageway.

20. The method of claim **19**, wherein directing the cooling fluid through the fluid passageway includes receiving the cooling fluid from a body of water in which the marine craft is operating.

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